Background:
The calf is an important group of muscles for forward propulsion during walking. The calf is commonly impaired in children with cerebral palsy (CP) and receives the focus of treatments such as botulinum toxin, surgery and physiotherapy. Children with cerebral palsy (CP) have smaller lower limb muscles compared to their less impaired limb and to the limbs of typically developing children (TD). The medial gastrocnemius (MG) muscle of pre-school children with CP grow at a slower rate than TD peers. Muscles of the calf also incorporate the lateral gastrocnemius (LG) and the soleus (SOL) in the plantar flexor group and the tibialis anterior (TA) as the primary dorsiflexor of the ankle. The stimulus for growth of these muscles may be different to MG due to varied treatment, mechanical loading and neuromuscular input and the growth rates remain unknown.

Aim:
To determine whether ambulatory children with CP age 2-12 years had different MG, LG, SOL and TA muscle growth rates.

Methods:
The MG, LG, SOL and TA muscle volume were measured using a validated freehand 3D ultrasound method. Linear regression examined the relationship between age and muscle volume for each muscle and ANCOVA compared the slopes of the regression lines (ml/month, muscle growth rate), p<0.05.

Participants:
30 children with CP (mean age 79 [SD 32] months, range 25-142 months, males/females 17/13, GMFCS I=12, GMFCS II=18, unilateral CP=9, bilateral CP=21, recruited through a tertiary hospital Paediatric Rehabilitation Service participated in the study. All participants had received previous intramuscular injections of botulinum toxin type-A to the calf muscles and lower limb physiotherapy for spasticity management.

Results:
There was a positive linear relationship between age and MG (r=0.81, p<0.001), LG (r=0.78, p<0.001), SOL (r=0.70, p<0.001) and TA (r=0.87, p <0.001). The muscle growth rate (slope) of SOL, 0.76ml/month, was significantly greater than MG, 0.43ml/month (F=4.503, p=0.038), and LG, 0.36ml/month (F=7.067, p=0.012). The growth rate of TA, 0.50ml/month, was not different to MG (F=0.91, p=0.35), LG (F=3.55, p=0.07), and SOL (F=2.75, p=0.10).

Conclusion:
In this cross-sectional study of independently ambulant children with CP the trajectory of the SOL muscle growth was greater than that of the MG and LG muscles. The interaction of the growth and development of children with CP and the prescribed physiotherapy treatment and lower limb intramuscular botulinum toxin type-A injections may create different growth stimulus for the individual lower leg muscles. Clinically, to promote muscle size and strength, interventions such as progressive resistance training should be strongly considered from an early age in children with CP. Longitudinal studies in large cohorts of children with CP are required to further understand muscle growth.